2002 PIPING PLOVER ACTIVITIES
CAPE HATTERAS NATIONAL SEASHORE

Acknowledgements
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Breeding Activity

Cape Hatteras National Seashore (CAHA) continued to oversee Piping Plover (Charadrius melodus) breeding management during the year 2002. Efforts in 2002 included: 1) locating breeding plovers and nests, 2) protecting territories and nests, 3) monitoring nests and broods.

Location of Breeding Plovers and Nest
Beginning in early April, beaches were surveyed for plover activity. These surveys included sites that had been previously used for nesting as well as those deemed suitable but had no nesting documented in recent years. When plovers exhibited territorial or courtship behavior, the sites were investigated for the presence of nests. If none were found, the territories were revisited every two to seven days in attempts to locate newly initiated nests.

Territory and Nest Protection
Potential and known breeding sites were closed to the public in late March. Each area was surrounded by symbolic fencing, which consisted of posted signs and twine. All located nests were protected by predator exclosures. These have been used at CAHA since 1994.

Nest and Brood Monitoring
Nests were viewed from a distance every one or two days during incubation. Observers noted the behavior of adults, presence of predators and the condition of the predator exclosure. Nests were approached briefly once a week to closely inspect the exclosure, count eggs and search for any predator tracks. After hatching, each brood was monitored at one or two day intervals. Observers noted brood status, behavior, movements, human disturbance, predator contacts or other environmental interactions.

Results and Discussion

Productivity
Two pairs of Piping Plovers were found at CAHA during the 2002-breeding season (Table 1, Chart 1). This is the lowest breeding population recorded since monitoring began in 1989. Between 1989 and 1996, 11 to 15 pairs were identified annually. Numbers have declined each year since 1997.

This year's low of two pairs represents an 87% reduction from the peak number of 15 in 1989. The number of sites utilized by breeding birds is also in decline. In 1996, six areas of CAHA supported nesting. In 2002, breeding was only found at two sites, Hatteras Inlet spit and Bodie Island spit. This was the first year no breeding activity was found at Cape Point since monitoring began.

Other sites that were once known to have supported breeding activities, but have not been used in recent years, include South beach on Hatteras Inlet and the northern and southern tips of Ocracoke Island. Suitable habitat still appears to be present at these previous sites. However an increase in vegetation and shoreline changes have altered some sites. Recreational activities along CAHA beaches, including those near existing plover habitat, have risen greatly over the years.

Breeding activity was reported from neighboring lands in 2002. Two pairs of Piping Plover nested at Pea Island Wildlife Refuge (PIWR) and fifteen pairs at Cape Lookout National Seashore.

The two CAHA pairs produced three known nests this season (Table 2). One nest (33%) successfully hatched. Two nests (67%) were unsuccessful. The average clutch size was 3.5 eggs per nest. Of the eight known eggs, one (13%) hatched (Table 3, 3a). Chick production was the lowest on record since monitoring began. No chicks survived to fledgling age. Fledgling rate was 0.00, chicks per breeding pair, again the lowest on record (Table 4). Since 1989 productivity rates have ranged from 0.2 to 1.3. The average rate over the past ten years is 0.63 (Table 3a). All years have been below the recovery goal set by US Fish and Wildlife Service (USFWS) of 1.5 fledglings per breeding pair. The reduced breeding population we are now seeing is likely a reflection of low productivity over the years. According to USFWS, a population would need to produce 1.2 fledglings per breeding pair annually to sustain a population and higher to increase a population.

Nest Loss/Abandonment

Two nests (67%) were lost in 2002. The one breeding pair located at Hatteras Inlet spit initiated both. The initial nest was being incubated when waves undermined a protective dune allowing ocean overwash to flood the nest. The scattered eggs were collected and placed in an artificial scrape made within the predator closure. However, the adults did not return to the eggs. The pair's second nest containing one egg was lost to unknown causes though predation was likely. This nest had been in danger of flooding due to its location, which was approximately 20 feet from a pond fed by rain and overwash. Plans were to elevate the nest upon completion of egg laying, a procedure never attempted before at CAHA. A predator exclosure had not yet been put in place due to these plans.

Chick Mortality

One chick (100%) was lost to unknown causes however several possibilities were identified. The most disturbing possibility was that a visitor's dog might have been responsible. Large canid tracks were found in the area where the brood was often seen foraging and resting. Though the tracks were somewhat distorted due to rain, a professional trapper with the US Dept. of Agriculture examined the prints and verified them as domestic dog (*Canis familiarus*) tracks. The tracks were found running in a sharp turning pattern seeming to indicate that a dog had been engaged in a chase. Scrape marks where the dog was clawing in the sand were also evident. Red fox (*Vulpes vulpes*) depredation can not be ruled out since tracks of this species were seen within the closure but none indicating a chase. Heavy rains also coincided with the loss of the chick.

In previous breeding seasons between 1989 and 2001, chick losses ranged between 36% and 90% (Wrenn 1990, Collazo 1992-1994, Lyons 1995-2001). In past years, the majority of chicks were lost within ten days of hatching. This also proved true in 2002 with the loss of the 7-day old chick (Table 5, Chart 2).

Predator Exclosures

Predator exclosures were erected at two (67%) of the three nests. The third nest was to be exclosed after egg laying was complete and the nest elevated. It was lost to unknown causes prior to this. Fox homed in on one exclosure. Evidence of fox attempting to dig under the fence material on Bodie Island was documented two days prior to hatching. Red fox tracks were commonly recorded within the Bodie Island bird closure but only once at the exclosure.

Predator exclosures have been used at CAHA for the past nine years. Overall, their use has resulted in higher hatching rates. Between 1995 and 1998 hatch rates have ranged from 75% to 90%. However, in 1999, 2000 and 2002, rates were comparatively lower, where half of the exclosed nests (50%) successfully hatched. The lowest rate was recorded in 2001, when only 33% of exclosed nests were successful. Again, the number of nests and thus the sample size have greatly decreased over the years.

It was hoped that the use of predator exclosures would help boost overall fledgling rates but with few exceptions the rates have been low (Table 4a). Record highs were found in 1998 and 1999, with 1.3 and 1.2 respectively. The use of exclosures in combination with high food availability may have been responsible for increased productivity in 1998. Food availability studies conducted by CAHA in 1998 showed a five-fold increase in prey compared to a similar study in 1996 (Kuklinski and Fraser, 1996). If food availability is a highly variable limiting factor, chick survival may also be highly variable.

Predation

Two eggs disappeared on two different occasions at the Bodie Island nest. Ghost crabs likely rolled eggs out of the predator exclosure although such tracks were not visible on the hard packed sand. Ghost crabs were believed responsible for egg loss in past years at this site and at Hatteras Inlet spit. Though the cause of chick mortality at Bodie Island can not be absolutely confirmed, strong evidence of depredation by a domestic dog exists. Visitors often bring dogs to the beach. All pets must be leashed while at CAHA but the regulation is often ignored until a ranger arrives at the scene.

Plovers were seen exhibiting aggressive behavior towards gulls (*Laridae)* on four occasions, twice towards crows (*Corvidae)* and once towards a red fox. Tracks of crows, gulls, ghost crabs (*Ocypode quadrata*), domestic cats (*Felis domesticus*) and domestic dogs were documented within the piping plover breeding territories. By far, red fox tracks were the most common track seen at Hatteras Inlet spit and Bodie Island spit. After trapping activities took place, tracks were no longer seen at Hatteras and were reduced at Bodie Island (see Predator Removal). On three occasions a fox was seen walking through the closure at Bodie Island during daylight. Mink (*Mustela vison*) tracks were common at Ocracoke Island spit, where a plover exhibited territorial behavior but no breeding occurred.

Predator Removal

Red fox populations have been expanding their range southward in CAHA. They were first reported on Bodie Island in 1996 and on Hatteras Island in 2000. Their presence has impacted all ground nesting birds at Oregon Inlet flats, Cape Hatteras Lighthouse beach, Cape Point, South beach and Hatteras Inlet spit. The new Hatteras Island fox population likely used the Bonner Bridge as a corridor to the island last year. Mel Covey, a Buxton resident, observed a red fox moving south on the bridge in 1999. This route may be continuing. Kris Fair of PIWR observed a dead red fox on the bridge approximately 100 yards from the northern terminus in October, 2002. There are no historical records of red fox on Hatteras Island. In 2001, fox targeted two predator exclosures at Cape Point and Bodie Island causing nest abandonment and likely consumed egg(s) at Cape Point before being found by CAHA staff. Fox also impacted threatened loggerhead turtle eggs and hatchlings in 2001. Based on the continued and growing danger fox present to threatened species, CAHA decided to trap fox, concentrating on Hatteras Island. Funds were procured with the help of U.S. Fish and Wildlife Service. Professional trappers from the US Department of Agriculture (USDA) made two trips to the area in late June and July. Twelve fox were removed from Hatteras Island between Cape Point and Hatteras Inlet in June. Additional twelve animals were removed from the dunes adjacent to the Bodie Island spit flats and the Bodie Island "bone yard," near the Bodie Island Light Station. In July an additional four fox were taken from Bodie Island, all from the same dune field area near the inlet flats. No fox could be trapped on Hatteras Island in July. USDA believes that there may be one adult fox left along the South beach area, southwest of Cape Point. They also believe a den or two may be located at the north end of Hatteras Island, possibly within PIWR or the three northern villages of Rodanthe, Waves and Salvo. Numbers of red fox still remain on Bodie Island. Additional removal efforts are recommended for 2003.

Human Disturbance

Evidence of human entry was found at all plover breeding sites. Incidents of visitors entering posted bird closures at CAHA were documented between April and September of 2002. These closures not only represent sites where Piping Plover nested but also colonial waterbirds and American Oystercatcher (*Haematapus palliatus*). Most illegal entries were not witnessed but documented based on vehicle or pedestrian tracks left behind. Numbers are conservative since some individual records involved more than one vehicle or pedestrian. Also pedestrian tracks can be overlooked or dismissed, as we often don't know whether visitors or staff monitoring the sites made the tracks. Illegal pedestrian entry in the bird closures numbered 133 compared to 247 incidents recorded last year. In 2002, 45 occurred on Bodie Island, 85 on Hatteras Island and three on Ocracoke Island. Contacts were made with several people found defecating within the posted area. Judging by the amount of human feces and toilet paper left behind, this was one of the main reasons people entered the closures. People attempting to catch bait often enter where ponds or tidal coves exist. Other people contacted said they thought the closures were only for ORV's though the signs clearly stated pedestrian entry was also prohibited. Each entry required visitors to lift and stoop under the string that connected all posted signs.

A total of 52 incidents were recorded of ORV's entering posted bird closures. This number is similar to the 63 incidents recorded in 2001 and 58 vehicle entries documented in 2000. Of the 52 incidents reported in 2002, two occurred on Bodie Island, 36 on Hatteras Island and 14 on Ocracoke Island. These incidents required, at minimum, repairs to twine strung between posts

but often involved the replacement of broken posts and signs. At Bodie Island, an ultralight aircraft flew over the plovers three times from an altitude of approximately 100'. The birds became alert but did not fly away.

Non-Breeding Activity

Efforts to improve knowledge of Piping Plover use during the non-breeding season at CAHA began in 2000. Protocol was set by the North Carolina Wildlife Resource Commission (NCWRC) designating July 15 through April 1 of the following calendar year as the non-breeding season. Oregon, Hatteras and Ocracoke inlet areas as well as Cape Point were identified as being the most suitable habitats to survey for non-breeding plovers. Due to staff limitations, surveys were not as often as hoped, especially in the winter months. Frequency of surveys at Oregon and Hatteras inlets improved greatly in the fall of 2002 due to efforts of a local birder. Also included in the discussion below is data from neighboring PIWR, when known. Since both CAHA and PIWR contain areas within the Oregon Inlet system, it seems reasonable to include any counts available. Maddock compiled most of the 2002 PIWR survey counts.

During the 2000–2001 non-breeding period, spring and fall migrants were seen at all the sites surveyed. Wintering birds (Dec. through Feb.) were not seen at every site. This was the case at Cape Point and the north and south side of Hatteras Inlet where only a small number of migrants ranging between zero and six were recorded on a given date. Birds were not seen during the winter months. Ocracoke Island spit proved to be important to both migrants and wintering birds. Survey counts ranged from four to 22 birds during migration with zero to six in the winter months. The importance of a new flood tide shoal in Oregon Inlet (Green Island) as a wintering site became evident when NCWRC visited the site and found 11 Piping Plovers on February 1, 2002. Two weeks later, CAHA staff viewed the shoal from the Bonner bridge and spotted nine plovers, a conservative number since the entire shoal can not be viewed from the bridge.

The number of surveys increased in the 2001-2002 period and the same trend was found. Ocracoke Island spit had the largest number of migrants, with high counts of 37 and 26 birds found on two separate days in July and August. Wintering plovers at this site ranged between zero and eight birds. Wintering plovers used the entire Oregon Inlet system. Surveys between December 28, 2001 and January 15, 2002 recorded high counts of five birds at Bodie Island on the north side of the inlet and 18 birds at PIWR on the south side, with an additional 14 on Green Island.

Though the 2002-2003 survey season is not yet over, the frequent coverage at Oregon Inlet and Ocracoke Inlet has produced much data to date (Charts 3 and 4). The high count for the migration period at a single site was on Ocracoke Island spit with 56 Piping Plover on July 21, 2002. A high of 32 migrants on Bodie Island spit was also documented on July 21, 2002. Green Island had 20 migrants seen on August 5, 2002 by NCWRC. Four different sites were surveyed on October 18, 2002 with a combined total of 53 birds tallied (Bodie Island, 5; Pea Island, 12; Hatteras Inlet spit, 8; Ocracoke Island, 28). It was interesting to note that the majority of birds found on Ocracoke Island this day were spread along the 14 miles of beachfront as opposed to the inlets. Two weeks later, 14 plovers were again seen foraging along the Ocracoke beachfront. The three Oregon Inlet sites supported a combined total of 32 wintering birds on December 7, 2002 (Bodie Island, 9; Green

Island, 17; Pea Island, 6). The count at Green Island on this date was the highest wintering count for any one site. Bodie Island's wintering figures have ranged between five and nine birds with a range of three to 11 birds at Ocracoke Island spit.

A portion of Piping Plovers from the Canadian Maritime, Canadian Prairie and U.S. Great Lakes populations have been banded with different color combinations on their breeding grounds. U.S Atlantic birds are not banded. Known observations of 34 color-banded birds have been made at CAHA and PIWR between 1989 and 2003 (Appendix D). These represented migrating or over-wintering birds. The vast majority, 26, were reported in 2002. The sightings occurred near inlet systems. Oregon Inlet had 31sightingsand five at the north side of Ocracoke Inlet (the southern terminus of CAHA). Most of the plovers were verified as being from the Canadian Maritime Provinces. Of these eight, possibly nine, were New Brunswick bands; ten were from Nova Scotia, and one was probable a Newfoundland band. A color band sighting was likely from the Canadian coast but could not be confirmed. Additionally, bands from the Great Lakes region were reported 11 times. All of these were from Lake Superior except one from Lake Michigan. A North Dakota band and possibly one from Saskatchewan represented the prairie population. One report was so incomplete that no speculations were made of the band's origin. Not all of the 34 sightings represent different birds. Several bands were reported repeatedly in different years, months or weeks. A plover originating from Lake Superior was seen on ten different occasions between 2000 and 2002. In 2002, a New Brunswick plover was re-sighted five times at Oregon Inlet either on Green Island, an inlet shoal, or on the north end of PIWR. This same year, a Nova Scotia bird was re-sighted two times either at the southern portion of Bodie Island or Green Island. Another Nova Scotia band was reported seven times throughout all three of these Oregon Inlet sites in 2002.

Conclusions and Recommendations

The reduced number of breeding Piping Plover within CAHA is a dire situation. The loss of this nesting population would be significant. Breeding habitat is limited due to the presence of artificial dunes, vegetation encroachment and other human development inhibiting barrier island dynamics. However, the suitable habitat that remains is not being fully utilized by the species.

Fledgling rates remain below what the USFWS believes is necessary to sustain or rebuild a Piping Plover population at CAHA. The causes for low productivity remain uncertain. Some unidentified environmental factors may be further limiting this already stressed species. Predation is a known contributing factor at CAHA. Some avian and mammalian predators have likely increased due to human activities. Red fox have been vastly reduced on Hatteras Island this season but remain well established on Bodie Island. Fox removal must continue. In the past CAHA has engaged in a more aggressive program to reduce feral cat populations. This effort needs to continue in order to be effective. Present staffing levels are not adequate to maintain a viable trapping program. Human disturbances still exist. Though bird closures are clearly marked, pedestrians or vehicle operators do not always respect the posted areas. Visitors need to be made aware of their potential impacts - direct and indirect. Recreational activities, new and old, need to be examined for causing possible disturbances. The leash regulation must be widely and consistently enforced in all CAHA areas. Written warnings and citations have increased in some park districts in recent years. A greater law enforcement presence is critical as recreational use continues to increase each year. Surveys should

continue in order to learn where and to what degree plovers use CAHA in the non-breeding season. All Piping Plovers from areas north of CAHA have the potential of migrating through the park. Others over-winter here. Banded birds from the Canadian Maritime and Great Lakes population have been seen here consistently. It is important to provide protected habitat for these and all shorebird species during the non-breeding season.

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Table 1. Number of Piping Plover breeding pairs by site in Cape Hatteras National Seashore 1985-2002

	Total Pairs	Sites within Cape Hatteras National Seashore					
		Oregon Inlet	Cape Point	South Beach	Hatteras Inlet	North Ocracoke	South Ocracoke
1985	9						
1987	10	0	4	0	4	1	1
1989	15						
1990	14	0	8	0	4	2	0
1991	13	0	5	0	3	5	0
1992	12	0	4	0	4	4	0
1993	12	0	5	1	3	3	0
1994	11	0	5	1	3	2	0
1995	14	0	6	1	4	2	1
1996	14	1	5	1	5	1	1
1997	11	1	4	1	3	0	2
1998	9	0	4	1	3	0	1
1999	6	0	3	1	1	0	1
2000	4	0	2	0	2	0	0
2001	3	1	1	0	1	0	0
2002	2	1	0	0	1	0	0
average	11.2						

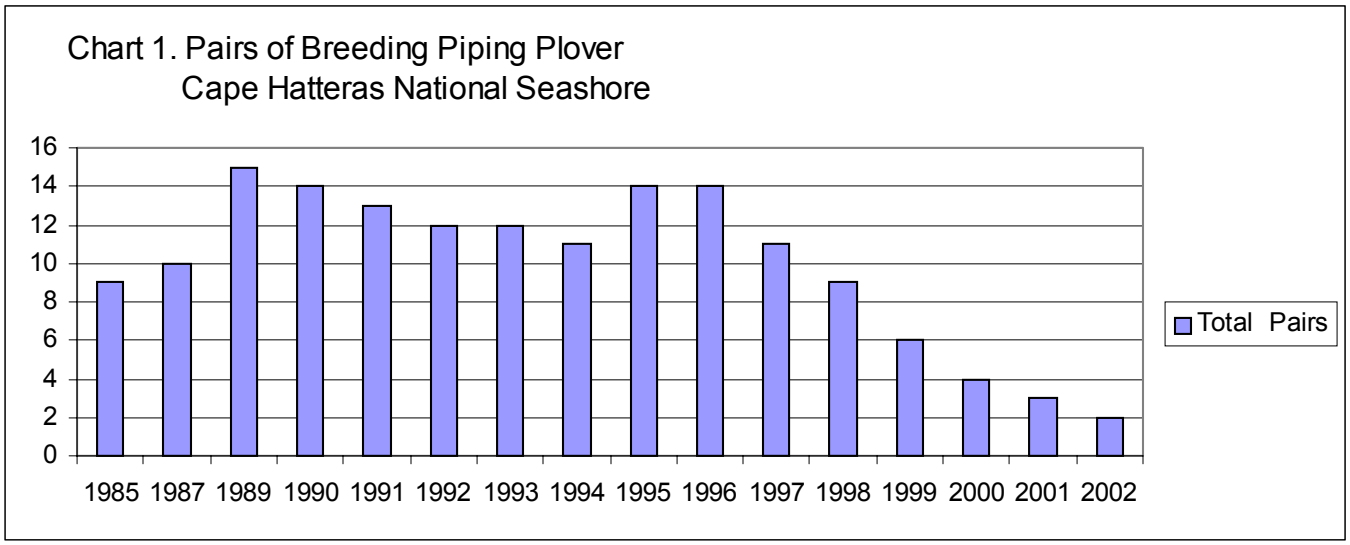

Table 2. Piping Plover nesting season at Cape Hatteras National Seashore 2002

LOCATION	# BREEDING PAIRS	# NESTS	# NESTS HATCHED	# NESTS LOST	# CHICKS FLEDGED	# CHICKS LOST
BODIE IS. SPIT	1	1	1	0	0	1
CAPE POINT	0	0	0	0	0	0
SOUTH BEACH	0	0	0	0	0	0
HATTERAS IS. SPIT	1	2	0	2	0	0
OCRACOKE NORTH	0	0	0	0	0	0
OCRACOKE SOUTH	0	0	0	0	0	0
TOTAL	2	3	1	2	0	1

Table 3. Piping Plover hatching success on Cape Hatteras National Seashore 2002

LOCATION	# NESTS	# EGGS	NESTS LOST / ABANDONED		NESTS HATCHED		EGGS HATCHED		NESTS W/ FLEDGED CHICKS	
		(a)	#	%	#	%	#	% (a)	#	%
BODIE IS. SPIT	1	3	0	0%	1	100%	1	33%	0	0%
CAPE POINT	0	0	0	0%	0	0%	0	0%	0	0%
SOUTH BEACH	0	0	0	0%	0	0%	0	0%	0	0%
HATTERAS IS. SPIT	2	5	2	100%	0	0%	0	0%	0	0%
NORTH OCRACOKE	0	0	0	0%	0	0%	0	0%	0	0%
SOUTH OCRACOKE	0	0	0	0%	0	0%	0	0%	0	0%
Total	3	8	2		1		1		0	

(a) -includes all eggs found

Table 3a. Piping Plover hatching success on Cape Hatteras National Seashore (1992-2002)

YEAR	# NESTS	# EGGS	NESTS LOST / ABANDONED		NESTS HATCHED		EGGS HATCHED		NESTS W/ FLEDGED CHICKS	
			#	%	#	%	#	%(a)	#	%
1992	14	49(e)	6	43%	8	57%	17	35%	6	43%
1993	21	69	12	57%	9	43%	27	39%	5	24%
1994	18	65(c)	8	44%	10	56%	32(d)	49%	6	33%
1995	19	63	6	32%	13	68%	30	48%	6	32%
1996	16	56(b)	6	38%	10	63%	30	53%	2	13%
1997	16	47(b)	6	38%	10	63%	32	68%	2	13%
1998	8	31	2	25%	6	75%	20	65%	5	63%
1999	6	23	3	50%	3	50%	11	48%	3	50%
2000	6	23	3	50%	3	50%	10	44%	2	33%
2001	3	10	2	67%	1	33%	3	30%	1	33%
2002	3	8	2	67%	1	33%	1	13%	0	0%

(a) - of all known eggs

(b) - assumes 1 egg from a brood whose nest was not found

(c) - assumes 2 eggs from a brood whose nest was not found (see 1992 report)

(d) - includes those presumed hatched (see 1994 report)

(e) - assumes 3 eggs from a brood whose nest was not found (see 1992 report)

Table 4. Fledging success of Piping Plovers on Cape Hatteras National Seashore for 2002.

LOCATION	# PAIRS	# BROODS	# CHICKS	AVE. BROOD SIZE	CHICKS FLEDGED		BROODS WITH FLEDGED CHICKS		FLEDGE RATE
				chicks/brood	#	%	#	%	chicks/pair
OREGON INLET	1	1	1	1.0	0	0%	0	0%	0.00
CAPE POINT	0	0	0	0.0	0	0%	0	0%	0.00
SOUTH BEACH	0	0	0	0.0	0	0%	0	0%	0.00
HATTERAS INLET	1	0	0	0.0	0	0%	0	0%	0.00
NORTH OCRACOKE	0	0	0	0.0	0	0%	0	0%	0.00
SOUTH OCRACOKE	0	0	0	0.0	0	0%	0	0%	0.00
Total	2	1	1	1.0	0	0%	0	0%	0.00

Table 4a. Fledging success of Piping Plovers on Cape Hatteras National Seashore 1992-2002

YEAR	# PAIRS	# BROODS	# CHICKS	AVE. BROOD SIZE	CHICKS FLEDGED		BROODS WITH FLEDGED CHICKS		FLEDGE RATE
				chicks/brood	#	%	#	%	chicks/pair
1992	12	8	17	2.1	8	47%	6	75%	0.67
1993	12	9	27	3.0	8	30%	5	56%	0.67
1994	11	10(a)	32(b)	3.2	9	30%	6	60%	0.82
1995	14	13	30	2.3	7	23%	6	46%	0.50
1996	14	10	30	3.0	3	10%	2	20%	0.21
1997	11	10	32	3.3	3	9%	2	20%	0.27
1998	9	6	20	3.3	12	60%	5	83%	1.33
1999	6	3	11	3.7	7	64%	3	100%	1.20
2000	4	3	10	3.3	3	30%	2	67%	0.75
2001	3	1	3	3.0	2	67%	1	100%	0.67
2002	**2**	**1**	**1**	1	0	0	0	0	0.00

(a) - includes 2 broods whose nest was presumed hatched (see 1994 report).
(b) - includes 8 chicks from 2 nests that was presumed hatched (see 1994 report).

Table 5. Age distribution of Piping Plover chick mortalilty on Cape Hatteras National Seashore 1990-2002

	Age (days)																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total
1990	3	3	1	2	4	1	1	2	1			2	2		1											20
1991				1	2	1	1	3	5	2	1							3								19
1992			2	1	2	2	2			1				1					1							12
1994		2		6					1	1	2					1	1		1							15
1995	2		7	2	2	3	1	2	1		1	1	1													21
1996	1	4	8	2	4	1			3			2	1												1	26
1997		2	3	5	5	1	1	4				1	1	1	2	1			2							29
1998		2	1				2	1		1													1			8
1999	1	2			1																					3
2000	2	1		2	1							1														5
2001			1																							1
2002							1																			1
																										1
1990-2002	9	16	22	21	21	9	9	12	11	5	4	7	5	2	3	2	1	3	4	0	0	0	1	0	1	

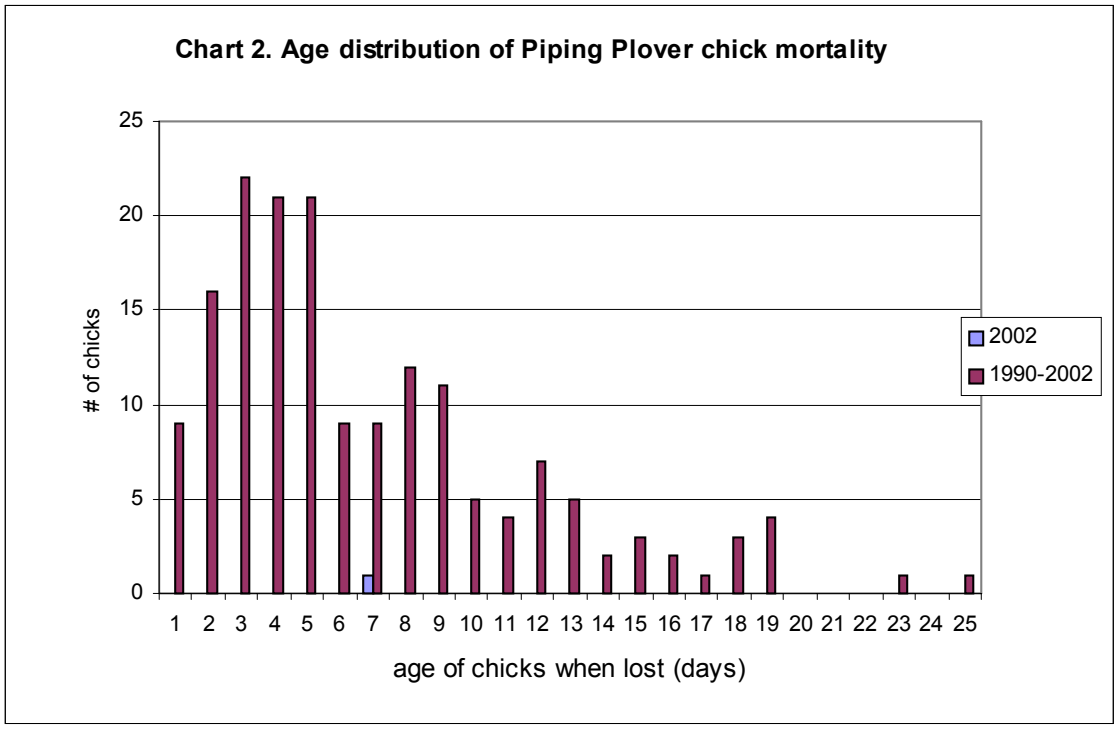

Chart 3. Non-Breeding Piping Plover Peak Counts
Ocracoke Inlet Spit, July - December, 2002

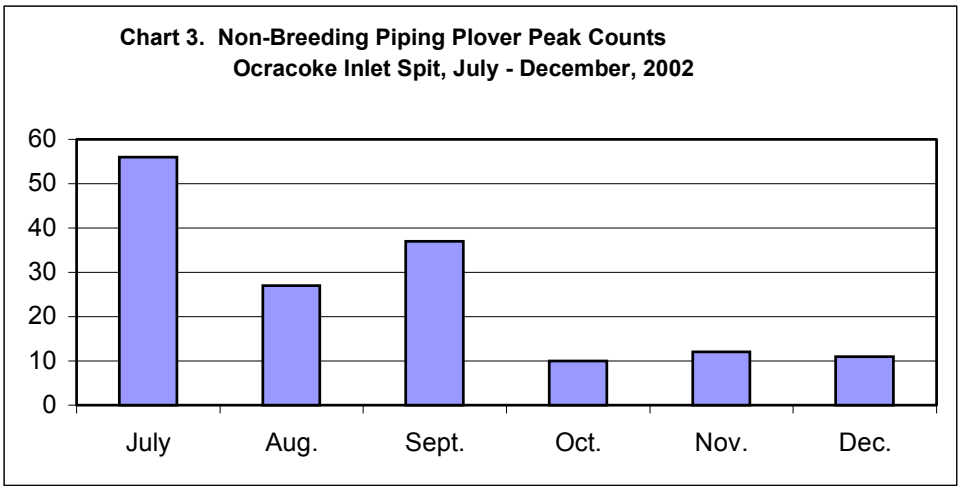

Chart 4. Non-Breeding Piping Plover Counts
Oregon Inlet, July - December, 2002